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Smartphones and high-tech laboratories to reveal health effects of environmental pollutants

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New technologies for sensing chemicals that people are exposed to and their effects in the body will help scientists work towards a complete picture of how environmental pollutants influence health in a major EU initiative being launched today.

Researchers will use smartphones equipped with GPS and environmental sensors to monitor potential hazards that study participants are exposed to. This information will be combined with blood and urine analysis to investigate whether exposure to risk factors leaves chemical fingerprints that can be detected in bodily fluids.

Two projects will be launched jointly today, addressing complementary aspects of the "exposome"[1]. The exposome is the sum of all of the environmental components, including lifestyle factors and chemicals we are exposed to, that influence our health over the course of a lifetime. The new projects will develop high-tech tools to improve our ability to measure the exposome, with a particular focus on multiple chemical exposures in food, air, and water during critical periods of life.

The first of the two projects is entitled Exposomics, valued at €8.7 million and involving 12 partner institutions led by Imperial College London, with the participation of IARC. The other is the HELIX Project, of a similar value; it is led by the Centre for Research in Environmental Epidemiology (CREAL), involves 13 partner institutions, and is focused on the early-life exposome. Together, this joint launch marks the EU's biggest investment in environmental health research to date.

The scientist leading the Exposomics project, Professor Paolo Vineis from the School of Public Health at Imperial College London, says, "The sequencing of the human genome has provided a wealth of information about genetic susceptibility involved in disease, but it has become clear that the diseases with the greatest burden, such as cancer, diabetes, heart disease, and neurodegenerative diseases like Alzheimer's, are mainly caused by factors other than genetics. These are likely to include aspects of lifestyle and the environment, but the precise roles of different factors in causing diseases are not well understood".

The HELIX project will build an *early-life* exposome. Pregnancy and the early years of life are well recognized to be periods of high susceptibility to environmental damage with lifetime consequences. Dr Martine Vrijheid, from CREAL and coordinator of HELIX, adds, "Characterisation of the exposome in early life can provide very effective tools for disease prevention, given that interventions at that time can reshape biological programming and shift the body's developmental track to the normal function". This makes early life a major starting point for development of the exposome.

Dr Christopher Wild, the Director of the International Agency for Research on Cancer, who first developed the concept of the exposome and is a partner on the Exposomics project, says, "It is a major step forward to have European funding directed to this area of research, which is critical for effective prevention of a number of non-communicable diseases".

Professor Vineis adds, "We are all exposed to low levels of environmental pollutants every day, such as diesel exhaust, tobacco smoke, and pesticides. It's very difficult to assess the health effects of these exposures, because often there are no unexposed people to compare with. These projects will make use of new technologies that allow us to measure personal exposure to pollutants with much greater sensitivity and study their effects in the body. The results will help us develop a better understanding of how exposures to many different pollutants combine to influence our risk of diseases". Dr Vrijheid also comments that "the results of the projects will help us to form a global view on how various types of exposures co-exist and jointly impact on health".

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[1] Wild CP (2005). Complementing the genome with an ''exposome'': the outstanding challenge of environmental exposure measurement in molecular epidemiology. *Cancer Epidemiol Biomarkers Prev*, 14:1847–1850. doi:10.1158/1055-9965.EPI-05-0456

Rappaport SM, Smith MT (2010). Environment and disease risks. *Science*, 330:460–461. doi:10.1126/science.1192603

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The researchers are developing a personal exposure monitoring kit, which could provide a more comprehensive assessment of study participants' environment. The kit, which could become commercially available in the future, includes a smartphone app that records the user's physical activity and location, and air pollution measurements from a sensor that plugs into the phone.

The researchers will also look for signatures left by risk factors inside the body, including changes in DNA, RNA, proteins, and metabolites, and altered levels of chemicals in blood and urine. The first results are expected to emerge within two years.

A virtual press conference will take place at 14:15 (Paris time). Details in the cover email.

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Notes to editors

1. Exposomics project partners

Imperial College London (UK), University of Utrecht (Netherlands), International Agency for Research on Cancer (IARC) (France), Fundacio Centre de Recerca en Epidemiologia Ambiental (CREAL) (Spain), Universiteit Maastricht (Netherlands), Institute of Biological Research and Biotechnology, National Hellenic Research Foundation (Greece), Schweizerisches Tropen- und Public Health-Institut (Switzerland), King's College London (UK), Genedata AG (Switzerland), University of California, Berkeley (USA), University of Bristol (UK), Centre de Recerca i Innovacio de Catalunya SA (Spain)

2. About Imperial College London

Consistently rated amongst the world's best universities, Imperial College London is a science-based institution with a reputation for excellence in teaching and research that attracts 14,000 students and 6,000 staff of the highest international quality. Innovative research at the College explores the interface between science, medicine, engineering, and business, delivering practical solutions that improve quality of life and the environment – underpinned by a dynamic enterprise culture.

Since its foundation in 1907, Imperial's contributions to society have included the discovery of penicillin, the development of holography, and the foundations of fibre optics. This commitment to the application of research for the benefit of all continues today, with current focuses including interdisciplinary collaborations to improve global health, tackle climate change, develop sustainable sources of energy, and address security challenges.

In 2007, Imperial College London and Imperial College Healthcare NHS Trust formed the UK's first Academic Health Science Centre. This unique partnership aims to improve the quality of life of patients and populations by taking new discoveries and translating them into new therapies as quickly as possible.

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3. HELIX Project

HELIX stands for: “The Human Early-Life Exposome – novel tools for integrating early-life environmental exposures and child health across Europe”.
CREAL (Centre for Research in Environmental Epidemiology) is a public research institute established in 2005. Its remit is to promote and develop advanced environmental epidemiological research, in order to help prevent and control harmful effects on human health.
Websites: www.projecthelix.eu and www.creal.cat

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